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(54) Title: A METHOD AND GATEWAY TO SUPPORT HANDOVER OF WIRELESS COMMUNICATION CALLS

(57) Abstract: A communication device provides handover of an active session between a packet switch network and a circuit switch network. The communication device may be a handover gateway. The call or session may be initiated between a mobile communication device and a terminal device. The handover gateway allows handover of the active session.

A METHOD AND GATEWAY TO SUPPORT HANDOVER OF WIRELESS COMMUNICATION CALLS

TECHNICAL FIELD

This invention generally relates to packet switch (PS) networks and circuit switch (CS) networks and more particularly relates to handover between a packet switch network and a circuit switch network during an active session.

BACKGROUND ART

Voice or telephony services can now be provided over a packet-switched network, such as the Internet. These packet-switched-telephony networks are commonly referred to as IP telephony networks because the Internet Protocol (IP) is the primary protocol used over the Internet. One IP telephony standard is the International Telecommunications Union (ITU) H.323 standard. One example of an IP telephony network is known as a Voice over IP (VoIP) Network. The VoIP network may include a gatekeeper function, one or more gateways and a packet-switched network (e.g., a portion of the Internet). The gatekeeper function may provide call authorization for both accepting and placing calls in its zone or area of control. A gatekeeper can also allocate bandwidth, can maintain call detail records, and can perform other network management functions.

A packet-switched-telephony gateway bridges a circuit switch network such as the Public Switched Telephone Network (PSTN) and a packet-switch network such as an IP network or the Internet. The IP telephony gateway bridges the PSTN

and IP networks to allow phone-to-phone and phone-to-personal computer (PC), and multimedia communications (voice, video and/or data). The IP telephony gateway provides the appropriate translation between transmission formats (for example, H.225.0 of an H.323 endpoint to/from H.221 of an H.320 endpoint) and between communication procedures (for example, H.245 of an H.323 endpoint to/from H.242 of an H.320 endpoint). The IP telephony gateway also performs call setup and clearing on both the network side and the switch circuit network side. Translation between video, audio, and data formats may also be performed in the gateway. In general, the purpose of the IP-telephony gateway is to complete the call in both directions between the packet switch network endpoint and the circuit switch network endpoint in a transparent fashion.

An example of an IP telephony gateway is the H.323 gateway (implementing the ITU H.323 standard). The H.323 gateway allows interoperation of H.323 systems with other audio/video conferencing systems on Integrated Services Digital Networks (ISDN), plain old telephone systems (POTS), Asynchronous Transfer Mode (ATM), and other transports. An IP telephony gateway operates as an endpoint on the IP-telephony network that provides real-time, two-way communication between IP telephony terminals on the IP-based network and other ITU terminals on a switched-circuit network, or to another IP-telephony gateway. Switch circuit network connectivity may be achieved in the IP telephony context by using gateways for H.320 (ISDN), H.324, H.323, POTS, and other endpoints on other networks.

networks and circuit switch networks in the sense that users are not allowed to roam between a packet switch network and a circuit switch network during an active call without disconnection.

DISCLOSURE OF INVENTION

It is, therefore, an object of the present invention to provide a communication device, such as a handover gateway, that provides handover of an active session between a packet switch network and a circuit switch network without disconnection of the active session.

The packet switch network and the circuit switch network each may include a plurality of entities. The communication device may function as a terminating entity to one of the networks and as one of the entities for the other network.

A method may be provided that includes initiating an active session between a mobile communication device and a terminal device both located in a first one of a packet switch network and a circuit switch network. The method may further include providing handover of the active session when the mobile communication device moves to a second one of the packet switch network and the circuit switch network.

Other objects, advantages and salient features of the invention will become apparent from the following detailed description taken in conjunction with the annexed drawings, which disclose preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and a better understanding of the present invention will become apparent from the following detailed description of example embodiments and the claims when read in connection with the accompanying drawings, all

forming a part of the disclosure of this invention. While the foregoing and following written and illustrated disclosure focuses on disclosing example embodiments of the invention, it should be clearly understood that the same is by way of illustration and example only and the invention is not limited thereto.

The following represents brief descriptions of the drawings in which like reference numerals represent like elements and wherein:

FIG. 1 shows an example call from a PSTN through an IP telephony network to another PSTN;

FIG. 2 shows a packet switch network, a circuit switch network and a handover gateway according to an example embodiment of the present invention in which the mobile communication device is located within the packet switch network;

FIG. 3 shows the components of the Figure 2 embodiment in which the mobile communication device is located within the circuit switch network; and

FIG. 4 shows an architecture of the handover gateway according to one example embodiment of the present invention.

BEST MODE(S) FOR CARRYING OUT THE INVENTION

The present invention will now be described with respect to the accompanying drawings. When appropriate, like reference numerals and characters may be used to designate identical, corresponding or similar components in differing figure drawings.

The embodiments of the present invention relate to any telecommunications network that provides support for its users to be able to handover an active session(s) from packet switch (PS) networks to circuit switch (CS) networks or vice

versa. The active session(s) may be any type of session or call including but not limited to a voice call, a multimedia call, a facsimile call or video. More specifically, the present application is related to wireless telecommunication systems whose users have mobility while the session(s) are active. The following embodiments are merely examples of the present invention. Other embodiments and configurations are also within the scope of the present invention. That is, the examples provided in this discussion do not limit the scope of the invention.

Examples of circuit switch networks includes GSM, ANSI-41 (in association with ANSI 136 and IS 95-B, UMTS Release 1999 and 2000, CDMA 2000 etc. Mobility of a mobile communication device within circuit switch networks is well known. An example of such handover will now be briefly described. Other methods of providing handover in circuit switch networks are also known. Handover may be controlled and initiated by the network. The serving base station controller (BSC) may monitor the mobility of the mobile communication device during an active session(s) with the help of signal quality and strength measurements provided by the mobile communication device. Measurement reports may indicate to the current BSC that the mobile communication device has moved to an area that is served (or serviced) by a different (target) BSC under a new mobile switching center (MSC).

Execution of the handover may involve two phases. In the first phase of the handover, the source BSC may initiate a set of signaling messages for the purpose of establishing a further communication path. The handover signaling exchanged may involve the serving MSC (i.e., the anchor MSC), the target MSC and the target BSC to allocate network and radio resources for the call. At the establishment of the

communication path, the mobile communication device is notified with the handover command about the target radio resources in the target BSC. During the second phase of the handover, the mobile communication device may act as the target BSC and the BSC may inform the anchor MSC through the target MSC about the completion of the handover procedure. The anchor MSC may switch the user plane toward the target MSC. In this way, the user plane goes through the already established network path and radio connecting after finishing the complete signaling for handover on both the radio and network side.

Examples of packet switch networks include GPRS, EGPRS (EDGE (Enhanced data rates for GSM evolution) GPRS), UMTS PS (UMTS packet switch), TR45.6 Adjunct Wireless Data Systems (CDMA packet architecture), Mobile IP, etc. Mobility of the mobile communication device within GPRS is also well known. An example of such handover will now be briefly described. Handover in a packet switch network may occur within radio/cellular telecommunications. General Packet Radio Service (GPRS) is a packet switch network for GSM cellular systems. Generally speaking, the handover procedure in packet networks can be divided into two steps, namely radio connection establishment to the target cell and network path optimization. The establishment of radio connection involves the source BSC/RNC communicating with the target BSC/RNC to setup the radio links with appropriate parameters for the call to be handed over. The radio resources are allocated and the source BSC/RNC commands the mobile communication device to handover to the target cell by providing information about the target cell resources (e.g. cell, radio channel). During this step, the core network may or may not be

involved. The second step is triggered after the first step by the source BSC/RNC and involves signaling exchange within the network elements and/or the mobile communication device for optimizing the transmission paths within the network. For GPRS systems, the second step involves the transfer of serving GPRS support node (SGSN) context information from source to target SGSN and a packet data protocol (PDP) context update between the target SGSN and the gateway GPRS support node (GGSN). The second step involving the network path optimization is only needed when the target cell belongs to a different core network entity (e.g. SGSN) as the source cell.

The handover procedure in the GPRS network is performed as a procedure called hard handover with serving radio network system (SRNS) relocation. The above described steps are interleaved to complete the handover procedure. For universal mobile telecommunication systems (UMTS), the first step may be performed implicitly by the radio network controller (RNC) as a soft handover procedure and the second step for path optimization may involve the serving radio network controller (SRNS) relocation. In the universal mobile telecommunication UMTS, a handover procedure like the GPRS systems may also be performed. This may depend on whether there is a direct link between the two RNCs. An implicit soft handover may be performed when a link exists between the RNCs.

In contrast to the above described networks, the present invention may allow a user (i.e., a mobile communication device) to perform handover when moving during an active session(s) from a circuit switch (CS) network to a packet switch (PS) network or when moving during an active session(s) from the packet switch

network to the circuit switch network. This is desirable since IP based networks have gained acceptance in the mobile community as the main stream solution for telecommunication services and also to provide the Internet connectivity to the subscribers. Thus, IP based networks should be capable of supporting call (or session) handovers from circuit switch networks or to circuit switch networks. This may provide a quality service with wide network coverage and service continuity to their subscribers.

Embodiments of the present invention may be accomplished by an entity called a handover gateway such as the handover gateway 300 shown in Figure 2. The handover gateway 300 provides a functionality between a packet switch network 100 and a circuit switch network 200 for the call (real time and non-real time) handover purposes. The handover gateway 300 is a gateway for the conversion from packet data to the circuit connection and vice versa introduced for handover purposes. That is, the handover gateway 300 converts packet data units from the packet switch network to packet data units compatible with the circuit switch network 200 and vice versa. The handover gateway 300 may exchange the handover related protocol signaling (e.g., GTP, RANAP, RNSAP, MAP, IS-41) that is supported in both packet switch and circuit switch networks to complete the handover procedure. The handover gateway 300 may also maintain mapping between packet sessions and circuit connections. It may also handle subsequent handovers back to the network where the call (or session) was originally initiated.

More specifically, Figure 2 shows an example packet switch network 100 and an example circuit switch network 200. Other embodiments and configurations of

both the packet switch network and the circuit switch network are within the scope of the present invention. That is, Figure 2 is merely an example illustration and does not limit the scope of the present invention. The handover gateway 300 provides a communications path between the packet switch network 100 and the circuit switch network 200. In this example, the packet switch network 100 may include a router 102 coupled to a router 104 by a signal line 103. The router 104 may be coupled to a node (i.e., a node B) 106 by a signal line 105. The packet switch network 100 would likewise include other routers that are not shown. In contrast, the circuit switch network 200 may include an MSC 202 coupled to a radio access network (RAN) 204 by a signal line 203. Other entities may also be provided within the circuit switch network 200. The handover gateway 300 may be considered an entity of both the packet switch network 100 and the circuit switch network 200.

In the Figure 2 example, a mobile communication device 50 is shown physically within an area serviced by the packet switch network 100. The active session may be initiated in a well known manner between a terminal 110 coupled to the router 102 and the mobile communication device 50. The mobile communication device 50 may be any type of mobile entity (or terminal) including but not limited to a mobile phone, a pager or a mobile computation apparatus. Information may be propagated through the packet switch network 100 from the terminal 110, along signal line 112 to the router 102, along the signal line 103 to the router 104 and along the signal line 105 to the node 106. The node 106 may communicate with the mobile communication device 50 along the transmission path 55. The transmission path 55 may include a wireless transmission path.

During the active session(s) and in accordance with the present invention, the mobile communication device 50 may physically move outside of the area serviced by the packet switch network 100. For example, Figure 3 shows that the mobile communication device 50 has physically moved from the area serviced by the packet switch network 100 to the area serviced by the circuit switch network 200. Embodiments of the present invention allow movement of the mobile communication device 50 during an active session(s) between the mobile communication device 50 and the terminal 110 without disconnection of the session(s). In order to perform this mobility and maintain the active session(s), the handover gateway 300 supports the handover. After handover, the transmission path of the call (or session) may include a path from the terminal 110, along the signal path 112 to the router 102, along the signal line 103 to the router 104, and along the signal line 120 to the handover gateway 300 that performs the functionality described above and below. It is understood that the transmission may occur between different routers that are not shown in Figure 3 as long as the information is transported from the terminal 110 to the handover gateway 300. The transmission path of the call (or session) may now also include a path from the handover gateway 300, along a signal line 220 to the MSC 202, along the signal line 203 to the RAN 204 and along the transmission path 57 to the mobile communication device 50. The transmission path 57 may include a wireless transmission path.

The mobile communication device 50 has therefore moved from the packet switch network 100 to the circuit switch network 200 during an active session(s). The mobile communication device 50 may subsequently move from the circuit switch

network 200 back to the packet switch network 100 by utilizing the handover gateway 300 or another similar handover gateway 300. The mobile communication device 50 may also physically move from the circuit switch network 200 to a different circuit switch network (not shown) using well known techniques such as that described above.

The present application is also applicable to the active session(s) being initiated while the mobile communication device 50 is within the circuit switch network 200. The present invention allows the mobile communication device 50 to move from the circuit switch network 200 to the packet switch network 100 without disconnection of the active session(s). This is likewise accomplished through the use of the handover gateway 300. In this circumstance, Fig. 3 would show the mobile communication device 50 initially in the circuit switch network 200 and Fig. 2 would show the mobile communication device in the packet switch network 100 after handover. The mobile communication device 50 may also physically move from the packet switch network 100 to a different packet switch network (not shown) using techniques such as that described above.

The handover gateway 300 will now be described in more detail. Figure 4 shows an example architecture of the handover gateway 300. The below described functionalities and the architecture shown in Figure 4 are merely one example of the handover gateway as other embodiments, configurations and functionalities are also within the scope of the present invention. The handover gateway 300 may be coupled to a router or other entity within one of the networks or the handover gateway may be its own entity. The handover gateway 300 may also function as an

entity on both the packet switch side and the circuit switch side. The handover gateway 300 may also be two or more separate network entities such as a generic router and a controlling handover control entity.

On the control plane, the handover gateway 300 may exchange packet switched (PS) related handover signaling 332 with the packet switch side of the network elements. The handover gateway 300 may perform appropriate conversions 330 or mapping between packet switch and circuit switch handover signaling 334. The handover gateway 300 may also exchange circuit switch related handover signaling with the circuit switch side of the network elements (MSC).

Based on the information exchanged during handover signaling, a mapping may be established between the media ports and circuit connections by providing the information to a gateway control unit 320 as shown in Figure 4. The gateway control unit 320 may act as an admission control function to control the media conversions between circuit switch and packet switch data. Internal control interfaces 322 and 324 may be used for communication within the handover gateway 300 and may be standardized interfaces like MGCP, Megaco etc. or vendor specific interfaces.

On the user plane, the handover gateway 300 may perform media conversion 310 between packet data 312 and the circuit (PCM) data formats 314 including transcoding and echo-cancellation. Specifically, the handover gateway 300 may provide IP transport addresses for media reception and transmission on the packet switch side of the handover gateway 300. Interfacing with the circuit switch network 200, the handover gateway 300 may have circuit connections or links to one or more

MSCs. Before allowing a successful handover, the handover gateway 300 may ensure the identity of the subscriber terminal device and/or network entity is authenticated. In some cases, the handover gateway 300 may check with the service level agreements (SLA) to allow or disallow a certain handover request. The authentication function may be performed as part of the admission control function in the gateway control unit 320.

In addition, the handover gateway 300 may also provide transmission and load information to the network management system for administrative purposes. User data may be collected for recording and charging purposes. This information may be reported to the charging/billing network entities. Privacy and security of both signaling and media may be provided according to the adopted standards in the handover gateway 300. The handover gateway 300 may report to other network entities in case of certain signaling or media needs to be interceptible to meet restrictions enforced by the federal/legal laws.

The present invention provides a way for carriers to deploy IP based mobile networks incrementally while allowing users to have full mobility even during connections. It further allows a separate control plane from the user plane thus satisfying the requirements for IP based cellular networks. The handover gateway may be implemented as a separate network element or integrated with existing network elements. For example, the user plane part of the handover gateway may be implemented together with a roaming signaling gateway (R-SGW). If the handover gateway is used to support handoff to ANSI-41 networks, then the user

plane part of the handover gateway may have trunk connections with the target ANSI-41 mobile switching centers.

The present invention has been described with reference to a number of illustrative embodiments. One skilled in the art would understand that numerous other variations, modifications and embodiments are within the spirit and scope of the principles of this invention. The variations, modifications and embodiments are also within the scope of the present invention.

What is claimed is:

1. A communication device that provides handover of an active session between a packet switch network and a circuit switch network.

2. The communication device of claim 1, wherein said packet switch network comprises a plurality of entities and said circuit switch network comprises a plurality of entities, wherein said communication device functions as a terminating entity to said packet switch network and said communication device functions as one of said entities for the circuit switch network.

3. The communication device of claim 1, wherein said packet switch network comprises a plurality of entities and said circuit switch network comprises a plurality of entities, wherein said communication device functions as a terminating entity to said circuit switch network and said communication device functions as one of said entities for the packet switch network.

4. The communication device of claim 1, wherein the communication device comprises a handover gateway.

5. The communication device of claim 4, wherein said handover gateway converts packet data units from said packet switch network to packet data units compatible with said circuit switch network.

6. The communication device of claim 4, wherein said handover gateway converts packet data units compatible with said circuit switch network into packet data units for said packet switch network.

7. The communication device of claim 4, wherein said handover gateway exchanges handover related protocol signaling.

8. The communication device of claim 4, wherein said handover gateway maintains mapping between packet sessions in said packet switch network and circuit connections in said circuit switch network.

9. A device that allows an active session between a mobile communication device and a terminal device to be handed over between a packet switch network and a circuit switch network.

10. The device of claim 9, wherein said packet switch network comprises a plurality of entities and said circuit switch network comprises a plurality of entities, wherein said device functions as a terminating entity to said packet switch network and said device functions as one of said entities for the circuit switch network.

11. The device of claim 9, wherein said packet switch network comprises a plurality of entities and said circuit switch network comprises a plurality of entities, wherein said device functions as a terminating entity to said circuit switch network and said device functions as one of said entities for the packet switch network.

12. The device of claim 9, wherein the device comprises a handover gateway.

13. The device of claim 12, wherein said handover gateway converts packet data units from said packet switch network to packet data units compatible with said circuit switch network.

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14. The device of claim 12, wherein said handover gateway converts packet data units compatible with said circuit switch network into packet data units for said packet switch network.

15. The device of claim 12, wherein said handover gateway exchanges handover related protocol signaling.

16. The device of claim 12, wherein said handover gateway maintains mapping between packet sessions in said packet switch network and circuit connections in said circuit switch network.

17. A method of communicating comprising:

initiating a session with a mobile communication device located in a first one of a packet switch network and a circuit switch network; and

providing handover of said active session when said mobile communication device moves from said first one to a second one of said packet switch network and said circuit switch network.

18. The method of claim 17, wherein said packet switch network comprises a plurality of entities and said circuit switch network comprises a plurality of entities, said handover being performed by a communication device that functions as a terminating entity to said packet switch network and functions as one of said entities for the circuit switch network.

19. The method of claim 17, wherein said packet switch network comprises a plurality of entities and said circuit switch network comprises a plurality of entities, said handover being performed by a communication device that functions as a

terminating entity to said circuit switch network and functions as one of said entities for the packet switch network.

20. The method of claim 17, wherein said handover is performed by a handover gateway.

21. The method of claim 20, wherein said handover gateway converts packet data units from said packet switch network to packet data units compatible with said circuit switch network.

22. The method of claim 20, wherein said handover gateway converts packet data units from said circuit switch network into packet data units for said packet switch network.

23. The method of claim 20, wherein said handover gateway exchanges handover related protocol signaling.

24. The method of claim 20, wherein said handover gateway maintains mapping between packet sessions in said packet switch network and circuit connections in said circuit switch network.

FIG. 1

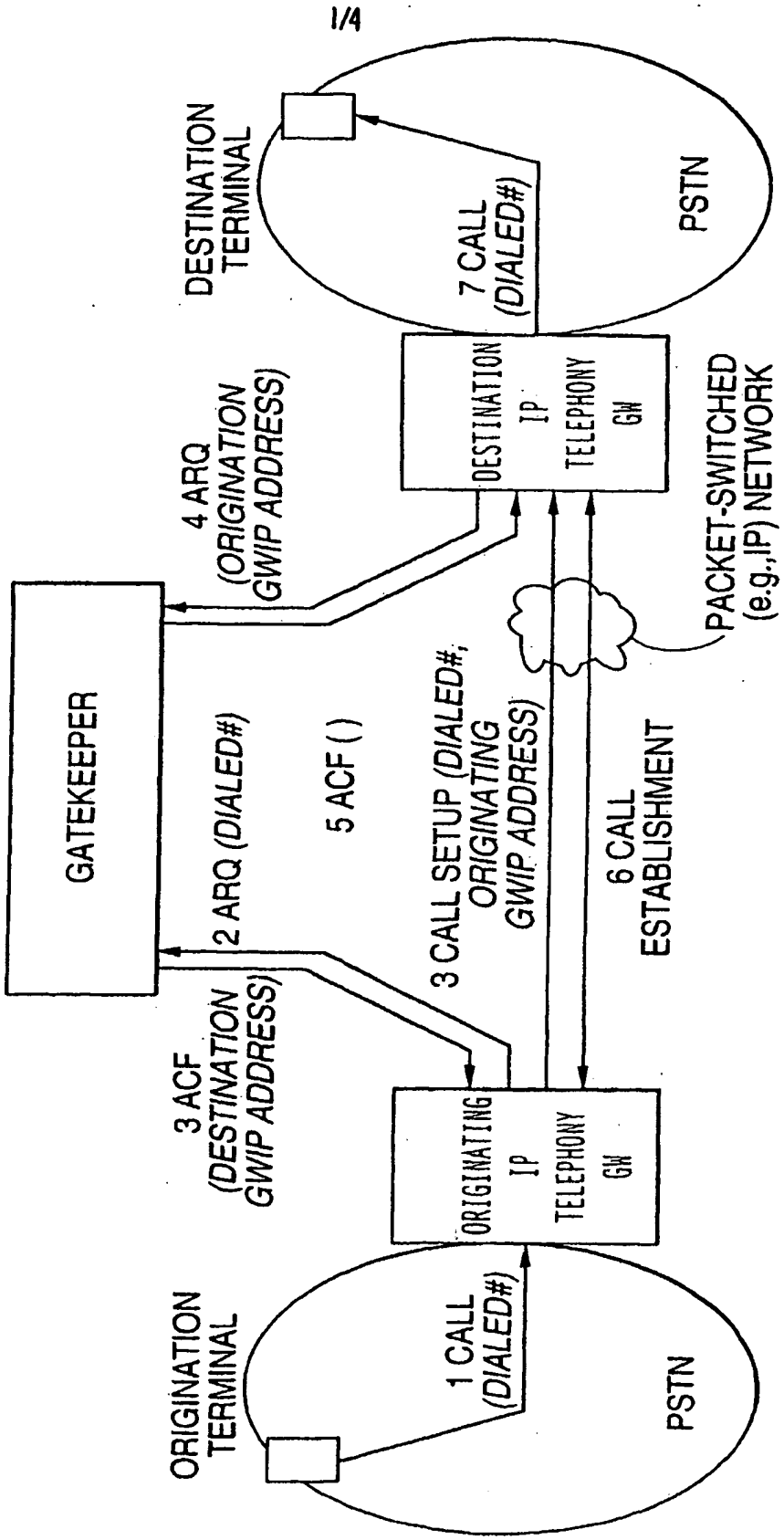

ORIGINATION TERMINAL
1 CALL (DIALED#)
PSTN
ORIGINATING IP TELEPHONY GW
3 ACF (DESTINATION GWIP ADDRESS)
GATEKEEPER
2 ARQ (DIALED#)
5 ACF ( )
3 CALL SETUP (DIALED#, ORIGINATING GWIP ADDRESS)
6 CALL ESTABLISHMENT
4 ARQ (ORIGINATION GWIP ADDRESS)
DESTINATION IP TELEPHONY GW
PACKET-SWITCHED (e.g.,IP) NETWORK
7 CALL (DIALED#)
PSTN
DESTINATION TERMINAL

FIG. 2

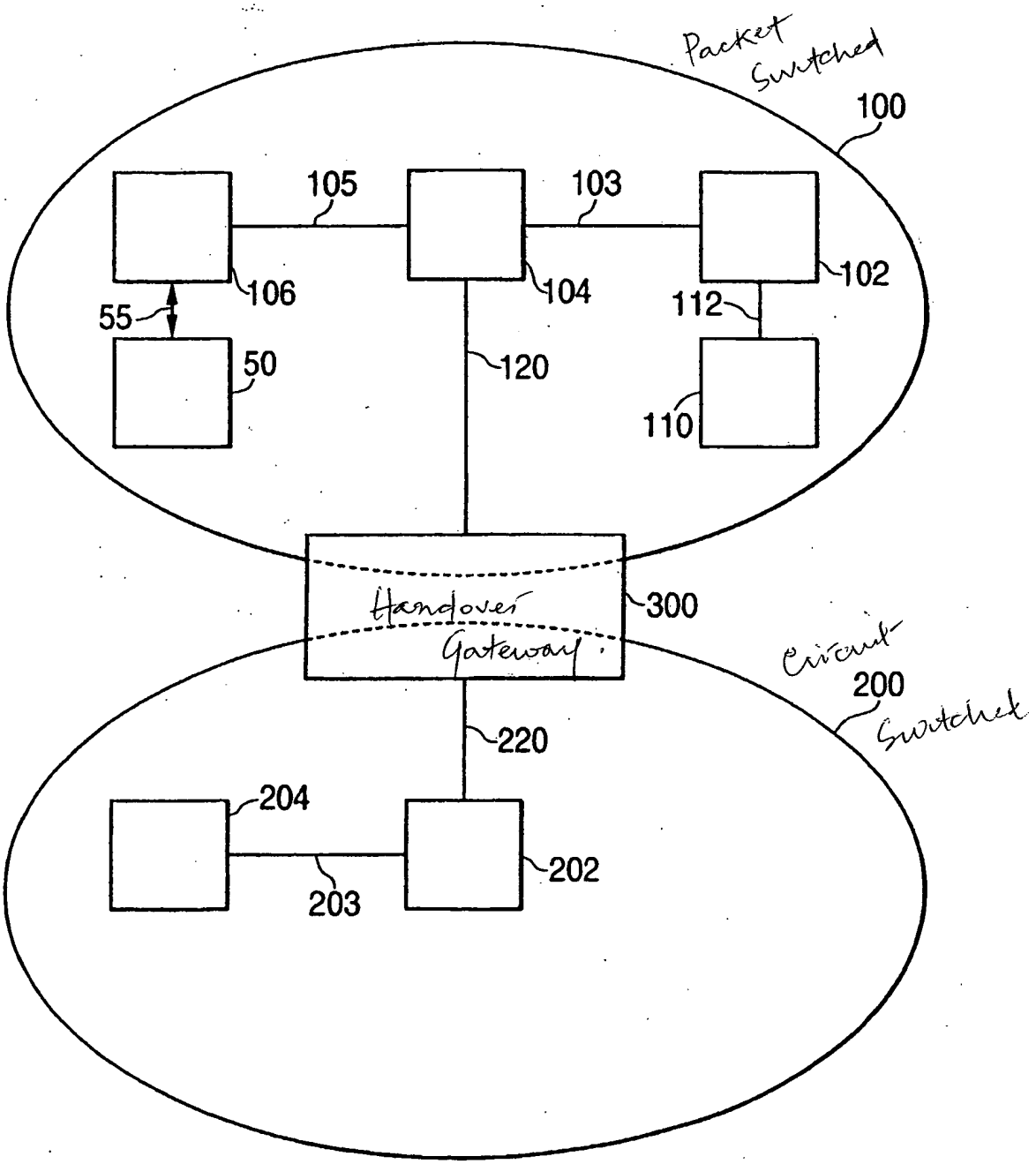
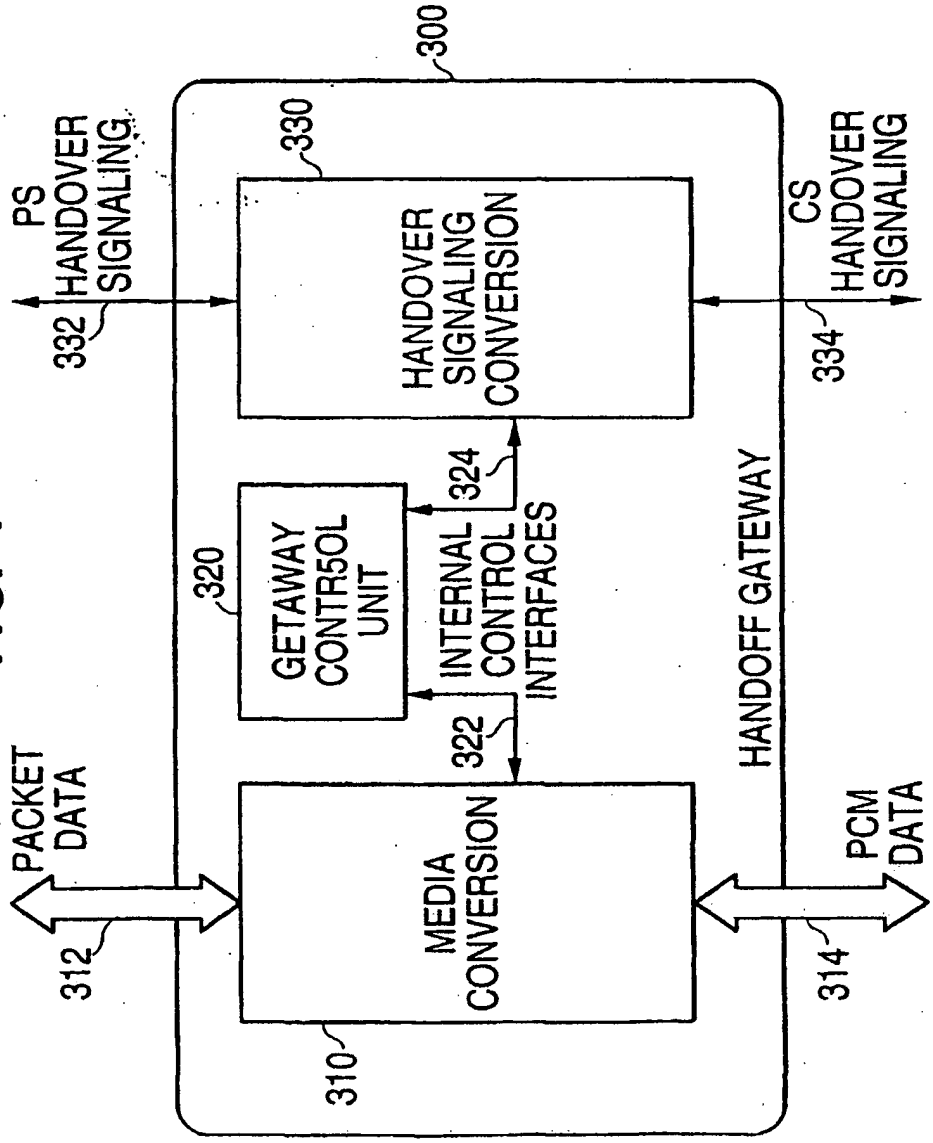

Packet Switched
100
105
103
106
104
102
55
112
50
120
110
300
Handover Gateway
Circuit-
200
Switched
220
204
202
203

FIG. 4


300
330
PS HANDOVER SIGNALING
332
HANDOVER SIGNALING CONVERSION
CS HANDOVER SIGNALING
334
324
320
GETAWAY CONTROL UNIT
INTERNAL CONTROL INTERFACES
322
HANDOFF GATEWAY
PACKET DATA
312
MEDIA CONVERSION
PCM DATA
314
310